6-4-1999

CropWatch No. 99-12, June 4,1999

Lisa Brown Jasa
University of Nebraska-Lincoln, ljasa@unlnotes.unl.edu

CROP WATCH

University of Nebraska Cooperative Extension
Institute of Agriculture and Natural Resources

No. 99-12
June 4, 1999

Check early planted fields first for European corn borer damage

European corn borer moth flight began on May 23 at Clay Center and Pierce and on May 27 at Aurora and Concord based on black light traps. *(Updated information on black light trap catches can be found at http://www.ianr.unl.edu/ianr/entomol/fldcrops/fldcrops.htm)*

Based on the degree day information previously published in *Crop Watch* (No. 99-8), first egg hatch should occur 212 degree days (base 50F) after first moth catch, and second instar larvae should first occur at 318 degree days after first moth catch. Peak egg hatch occurs 200-250 degree days after first hatch.

Larvae hatching from eggs laid on plants under the six-leaf stage will not survive well, due to the natural resistance factor DIMBOA found in smaller corn plants. As plants get larger (8-12 leaf stage), survival will increase as the DIMBOA level decreases within the plant. Moths prefer to lay eggs on taller plants (earlier planted fields) in an area. Because of this and the poor survival of borers on smaller plants, scouting should begin on earlier planted fields.

Now that B.t. corn is being planted widely, be sure you know whether the field you are scouting was planted to B.t. corn. Normally in B.t. corn, damage in the whorl stage of corn should be limited to a few tiny pin holes, where larvae initially fed before they ingested a lethal dose of B.t. toxin. Seed lots, however, may contain a small percentage of off-type seed (typi-

(Continued on page 113)

Inside

Crop options after herbicide use

With the recent precipitation, many corn stands, especially in southeast and western Nebraska have been damaged due to flooding and hail. Producers in these areas are scrambling to replant these fields either to corn or a more timely crop. Many preemergence herbicides restrict replant options and producers should use caution when faced with replanting. One method of planting into soil containing damaging herbicide residues is to set furrow openers on the planter to remove the surface soil. A heavy rain after planting would negate this technique and may result in the crop being "silted under." Use herbicides only "as needed" on the replant crop.

A sound strategy is to keep replant options in mind when choosing a herbicide for a given site. Understanding that herbicide choice with respect to replant options is not always possible, the following table lists planting options based on our judgment for various herbicides with the time delay required between application and planting. These estimates can be influenced by several factors including application rate, soil organic matter content, and pH. Always read and follow the herbicide label.

See table of recommended replant options on page 111

Jeff Rawlinson
Extension Weed Science
Alex Martin
Extension Weed Specialist

Field updates

Ralph Kulm, Extension Educator Holt County: We received .5 to .75 inches of rain over the long weekend. Producers with soybeans trying to come up through crusted soils are happy, those with alfalfa on the ground are less happy. Alfalfa weevils and bean leaf beetles are continuing to cause concern for alfalfa and soybean producers.

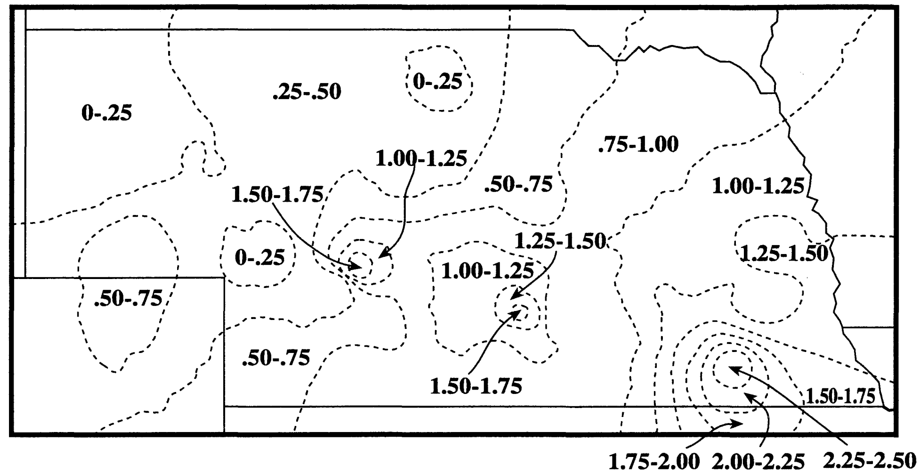
Steve Pritchard, Extension Educator in Platte County: Rainfall totals from last weekend ranged from 2.5 inches to over 6 inches in some areas. Some lowland flooding occurred along area streams. Some fields will need to be replanted as a result of crops washing out. Some producers reporting herbicide damage to corn fields. Alfalfa harvest has begun in the Platte Valley. Recent rains will keep any planting/replanting efforts at a standstill for a few days.

Ralph Anderson, Extension educator in Buffalo County: We did see some herbicide damage last week and will need some "reach back" for some of the early pre-plant applications to work.

We have experienced several "intense" storms this year. While planting is generally completed, a few areas have still not been planted and some experienced flooding washing and crusting. Grass and pastures are looking great.

Dave Varner, Extension educator in Dodge County: Rain continues to delay planting throughout much of Dodge County. Recent heavy rains have caused considerable lowland flooding along Maple Creek.

This seems to be the year of the black cutworm. Seasoned area crop consultants indicate that this is the most serious infestation that they have ever observed. Early detection of this pest is essential for successful control. *Corn Cutworms*, NebGuide G93-1153, contains excellent control options for this potentially serious pest.



Precipitation from May 18 to May 31

Heavy downpours last weekend caused lowland flooding and erosion in some areas of central and southeast Nebraska. Precipitation for the period in central to eastern Nebraska ranged from 50% of normal to as high as 300% of normal. Generally precipitation from Sept. 1 to May 31 is 80%-100% of normal for most of the state with southeast Nebraska and a pocket in northwest Nebraska reporting levels up to 140% of normal.

CROP WATCH

In print or on the Web 1999 University of Nebraska

Crop Watch is published from March to November by the University of Nebraska Institute of Agriculture and Natural Resources Communications and Information Technology, PO Box 830918, 108 Agricultural Communications Bldg., UNL, Lincoln, NE 68583-0918. To order either a printed or electronic (web) subscription or to change your address, write to *Crop Watch* at the above address or call (402) 472-7981. A sample copy of the Web version is available free at *http://www.ianr.unl.edu/cropwatchnews*

Lisa Jasa, Editor
Email: ljasa1@unl.edu

For more information about a particular subject, write the authors at the addresses below:

UNL Department of Entomology
202 Plant Industry Bldg.
Lincoln, NE 68583-0816

UNL Department of Plant Pathology
406 Plant Science Bldg.
Lincoln, NE 68583-0722

UNL Department of Agronomy
279 Plant Science Bldg.
Lincoln, NE 68583-0918

UNL Department of Agricultural Meteorology
236 L.W. Chase Hall
Lincoln, NE 68583-0728

GMOs and the genetics of special traits

The impact of genetics in crop production has always been important. Assessing the recent debate on the impact of genetics on crop safety and use has made terms such as GMO, transgene, input trait and output trait an essential part of producers' working vocabularies. The purpose of this article is to describe what GMO crops are and how they differ from non-GMO crops. We also will discuss the impact of genetics on input and output traits.

GMO vs Non-GMO

GMO stands for Genetically Modified Organism. This term is used by policy-making groups to describe genetically engineered organisms. The term is politically and economically relevant but not scientifically descriptive. Many organisms are genetically modified through naturally occurring or chemically induced changes in the DNA composition of genes (*see box at right*). STS soybean varieties and IMI corn hybrids are recent examples of genetically modified crops that are not GMOs. The unique herbicide resistance traits of these non-GMO varieties were derived from mutations or changes in genes that were already in the plant chromosomes. The modification that sets GMOs apart from non-GMOs is the insertion of a new gene or genes into the plant chromosomes through genetic engineering (*Fig. 1*). These new genes are called transgenes. "Transgenic" is a more specific description for plants that contain a transgene; however, GMO is becoming the more widely used adjective for these crops. Bt corn, Roundup Ready Soybean and Liberty Link Corn are the most widely grown examples of GMOs in Nebraska. The distinction between GMOs and non-GMOs has economic importance because some grain buyers are reluctant to accept GMOs. This resistance to the use of genetic engineering technology on crops is based on numerous objections. A table on page 109 summarizes some of the scientific issues surrounding the GMO debate. The European community is approving GMOs on a case by case basis. Consequently, growing a GMO versus a non-GMO can have marketing ramifications for farmers because of the political and personal preferences of buyers.

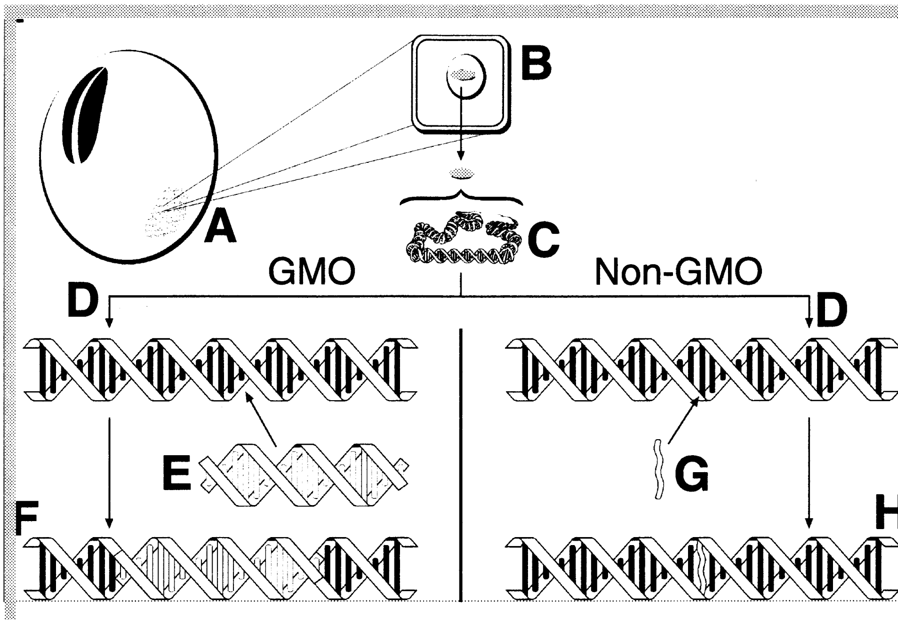


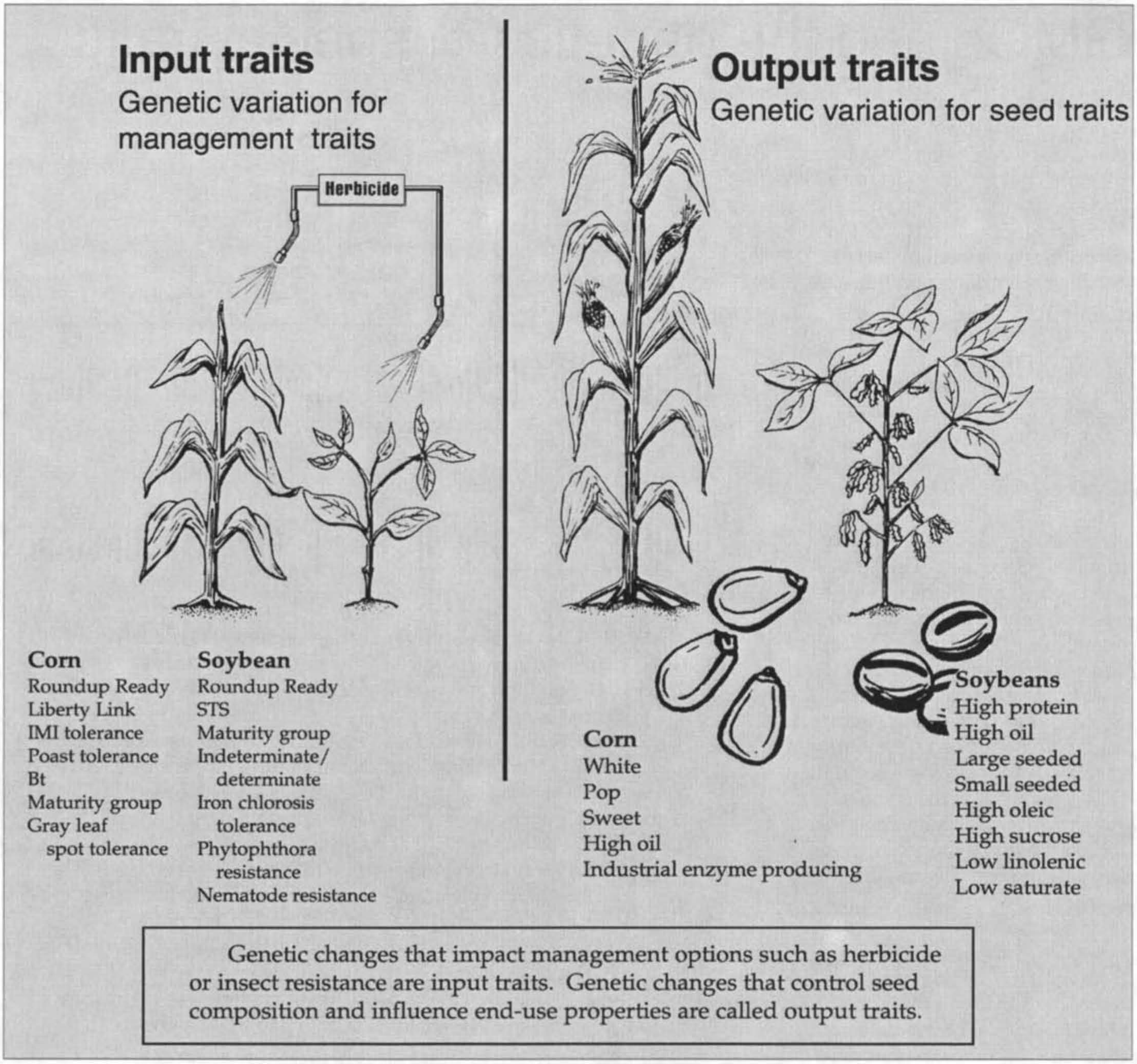
Fig. 1. GMO (genetically modified organisms) and non-GMO crops both have modifications in their genetic makeup but differ in the method and magnitude of the genetic change. Plants and seeds (A) consist of many cells (B). Chromosomes in the cell (C) contain the double helix DNA molecule (D) that stores genetic information. Millions of individual nucleotides (appearing as rungs on the helix spiral) make up the DNA information in a single cell. With GMOs, genetic engineering techniques are used to introduce into the cell a transgene (E) that could come from any living thing. This gene will contain the information to control a desired trait. The transgene inserts into the plant's chromosome (F) and becomes a permanent addition to the genetic information in the plant.

With non-GMO crops, changes as minor as a single nucleotide change (G) in an exisiting gene create a new version of the gene (H) that controls a new trait in the plant. These changes can occur from natural mistakes in DNA replication or be induced by chemical treatments.

Input vs. Output Traits

Genetic modification will have a biological impact on the crop variety. The genetic change may establish "input" traits that influence crop management during the growing season. The genetic change also may modify seed characteristics that determine the end-use value of the crop. These are called "output

(Continued on page 98)



Genetic changes that impact management options such as herbicide or insect resistance are input traits. Genetic changes that control seed composition and influence end-use properties are called output traits.

GMOs and non GMOs *(Continued from page 107)*

traits" (*see figure above*). Input traits such as the sulfonylurea tolerance in STS soybean (a non-GMO) and Roundup Resistance (a GMO) can influence the cost of producing the crop (*see page 110*). Output traits such as high oleic (a GMO) and high sucrose (a non-GMO) can open up alternative markets for the grain (*see page 110*). Often it is not possible to determine if a crop is a GMO or non-GMO based on the unique trait it posseses. In some instances, a similar trait can be derived from either mutagenesis or from genetic engineering. Input traits derived from genetic engineering have had the largest impact on crop production to date. As genetic discovery progresses, more options will become available to grow crops with specific attributes that add value to the grain. Farmers who implement identity preserved (IP) management will be able to take advantage of these new opportunities. The economic return from varieties with unique input or output traits will depend on each grower's production environments and their overall management practice.

Don Lee
Associate Professor of Agronomy

Scientific issues related to GMOs

Issue	*Con argument*	*Pro argument*
Transgene escape	Transgenes will escape to wild relatives of GMO crops and create weeds with the trait. Herbicide resistance genes are of particular concern.	The risk of this can be reduced. Herbicide resistance gene insertion is avoided in crops such as sorghum or oats that have weedy relataives growing in areas of cultivation.
Antibiotic resistance genes	Bacterial antibiotic resistance genes are used in cloning genes for genetic engineering. These genes could be transferred from the crop to other bacteria. Antibiotic resistance is a problem that genetic engineering could make worse.	An antibiotic resistance gene is inserted with the transgene of interest in some but not all GMOs. The risk of gene transfer from plant to bacteria is very low and the antibiotic resistance genes used are weak versions compared to antibiotic resistant genes causing health problems.
Narrow germplasm base	All Roundup Ready soybeans trace their ancestry to one plant. All Bt corn hybrids trace to four or five plants.	Plant breeders can, if given the time, maintain or increase genetic diversity by crossing GMO lines to other parents.
Magnitude of genetic change	The insertion of copies of the transgene into the crop plant chromosome is a relatively large change compared to a naturally occurring mutation in an existing gene. These changes could have a negative impact on the plant.	Genetic engineers and plant breeders know that many gene insertion events will produce undesired results. Transgenic plants are evaluated for their fitness and performance and the events that avoid undesired impacts are selected.
Unnatural process	The transfer of genes from one species to another is not a natural process.	Cultivated wheat is a result of interspecies crosses that happened in nature. A type of soil bacteria has been found with a natural system to transfer some of its genes to plant chromosomes.
Allergens	Genetically engineering plants to make new proteins can cause a food allergy response.	FDA requires testing of GMOs.
Ethics and unknown impacts	Technology that directs the transfer of genes from any potential source to the plant crosses the line of ethical manipulation of our crops.	Biotechnology has allowed us to better understand plant genetics. This technology is a tool we can use to help solve food production problems.

Input and output traits in corn and soybean

Trait name	*Trait description*	*GMO?*
Input traits in corn		
IMI	Resistance to ALS herbicides	No
SR	Poast herbicide tolerance	No
Gray leaf spot	Tolerance to gray leaf spot pathogen	No
Roundup Ready	Resistance to Roundup herbicide	Yes
Liberty Link	Resistance to Liberty herbicide	Yes
Bt, (Knock Out, Yield Guard, StarLink)	European corn borer resistance. Five different Bt events have been commercialized.	Yes
Input traits in development in corn		
Rootworm res.	Resistance to corn rootworm	Yes
PPO res.	Resistance to PPO herbicides	Yes
Output traits in corn		
Energy dense	High oil and improved protein, topcross	No
Supercede	High oil, improved amino acid, hybrid	No
High oleic	High oleic acid level in the oil	No
Popcorn	Popcorn snack food	No
Industrial protein	Proteins for medical or industrial uses	Yes
Output traits in development in corn		
Low phytate	More phosphorous available for animal	No and Yes
Pharmecuetical	Proteins for medical uses, very low acres	Yes
Input traits in soybean		
STS	Resistance to ALS herbicides	No
IDC	Iron chlorosis deficiency resistance	No
SCN	Soybean cyst nematode resistance	No
Roundup Ready	Resistance to Roundup herbicide	Yes
Input traits in development in soybean		
Liberty Link	Resistance to Liberty herbicide	Yes
Output traits in soybean		
High protein	High protein percentage	No
Lox null	Low lipoxygenase enzyme, better flavor	No
High sucrose	Low levels of gas inducing sugars	No
Low linolenic	Better frying oil, improved flavor, stability	No
Low saturate	Low saturated fat content, salad oil	No
High Oleic	Higher stability, more healthy frying oil	Yes
Output traits in development in soybean		
High sucrose	Low gas, improved nutrition	No

Replant Options *(Continued from page 105)*

Herbicide	Replant Crops	Time Delay
Accent	Corn	None
Accent Gold	Corn	None
Aim	Corn	None
Atrazine	Corn, sorghum	None
Authority	Soybeans	None
Axiom	Corn, soybean	None
Balance	Corn	None
Banvel	Corn, sorghum	15-30 days
Basis Gold	Corn	None
Bicep Magnum TR	Corn	None
Beacon	Corn	None
Bicep/Bicep Lite	Corn, sorghum (safened seed)	None
Bladex	Corn	None
	Sorghum, soybeans	15-30 days
Broadstrike + Dual	Corn, soybeans	None
Broadstrike + Treflan	Soybeans	None
Buctril/Atrazine	Corn, sorghum	None
Bullet	Corn, sorghum (safened seed)	None
Canopy	Soybeans	None
Canopy XL	Soybeans	None
Celebrity	Corn	7 days
Clarity	Corn, sorghum	15-30 days
	Soybeans	1/2pt 14 days after 1"rain 1pt-28 days after 1" rain
Command	Soybeans	None
Cycle	Corn	None
	Sorghum (safened seed)	0-15 days
Dual/Dual II	Corn, sorghum (safened seed)	None
	Soybeans	None
Distinct	Corn	7 days
DoublePlay	Sorghum	30 days
EPIC	Corn	None
Eradicane	Corn	None
	Sorghum	30 days
	Soybeans	10-15 days
Exceed	Corn	None
Extrazine II	Corn	None
	Sorghum	15-30 days (depends on rate)
Field Master	Corn, sorghum (safened seed)	None
Frontier	Corn, soybeans	None
	Sorghum (safened seed)	None
First Rate	Soybeans	None
Guardsman	Corn, sorghum (safened seed)	None
Harness Plus	Corn, soybeans, Sorghum (safened seed)	None
Harness Xtra	Corn, sorghum (safened seed)	None

Herbicide	Replant Crops	Time Delay
Hornet	Corn	None
Laddok	Corn, sorghum	None
Lasso	Corn, sorghum (safened seed)	None
	Soybeans	None
Lariat	Corn, sorghum (safened seed)	None
LeadOff	Corn, sorghum (safened seed)	None
Liberty	Corn, sorghum, Soybeans	None
Liberty ATZ	Corn, sorghum	None
Lightning	IMI Corn	None
Marksman	Corn	None
	Sorghum	30 days
Matador	Corn, soybeans	None
Micro-Tech	Corn, soybeans	None
	Sorghum (safened seed)	None
Paramount	Wheat, sorghum	None
Peak	Corn, sorghum	None
Poast Plus	PP Corn, soybeans	None
Princep	Corn only	None
Prowl	Soybeans, sunflowers	None
Pursuit	Corn (IR, IT), Soybeans	None
Pursuit Plus	Soybeans	None
Python	Corn, soybeans	None
2,4-D	Corn	3-7 days
	Sorghum	10-30 days
	Soybeans	7-30 days
Ramrod	Corn, sorghum, Soybeans	None
Ramrod/Atrazine	Corn, sorghum	None
Raptor	Soybeans	None
Roundup Ultra	Corn, sorghum, Soybeans	None
Scepter	Corn (IMI), soybeans	None
Scorpion III	Corn	None
Skirmish	Soybeans	None
Spirit	IR, IMR corn	None
	Conventional corn	4 weeks
Steel	Soybeans	None
Sutan	Corn	None
	Sorghum	30 days
	Soybeans	10-15 days
Surpass	Corn, soybeans,	None
	Sorghum (safened seed)	None
Surpass 100	Corn, sorghum (safened seed)	None
Sutazine	Corn	None
	Sorghum	30 days
Topnotch	Corn, soybeans	None
	Sorghum (safened seed)	None
Tough	Corn, sorghum	None
	Soybeans	30 days
Treflan	Soybeans	None

Cultivation treatments for corn rootworms

Rootworm egg hatch is expected to start in southeastern and south central Nebraska this week. Hatch will occur somewhat later in northeast and western Nebraska.

Initial hatch is hard to detect in the field, as newly hatched rootworms are very small. One method to detect hatch is to dig up corn plants, carefully shake off soil from roots and put roots over a coffee can of water. A coarse wire screen platform can be placed over the top of the can to hold corn roots. As the roots dry out, rootworm larvae will fall out and drop into the water where they can be more easily seen.

After hatch occurs you should begin to scout continuous corn fields for corn rootworm larvae and damage, regardless of whether a soil insecticide was applied at planting. This will help determine whether an insecticide is needed if one was not used at planting, and provide a check of the effectiveness of planting time insecticide applications. In case of poor control, a rescue treatment can still be applied before too much damage has occurred.

To check for larvae in a field, dig a 7-inch cube of soil centered on the corn plant. Sample at least two plants at each of five sites in a field. Carefully search through the soil and plant roots for larvae. There are three larval instars (stages). The greatest amount of damage is done in the last stage. The table shows

Corn rootworm larvae

degree-day accumulations needed to complete development of different stages. The first instars are about 1/16 inch long and difficult to find without magnification. Often the first detected rootworms are second instars. Corn rootworm larvae are slender, cream-colored, with brown heads and a dark plate on the top side of the tail, giving them a double headed appearance. Mature larvae are 1/2 inch long. Searching through the soil and roots over a sheet of black plastic makes it easier to see the small white worms. There is no established treatment guideline for corn rootworm larvae, but some consultants advise treating if there are two or three rootworms per plant. This, however, is very dependent on an individual's ability to find rootworm larvae in the soil.

Cultivation time insecticide treatments, if needed, should be applied soon after egg hatch. These applications are an effective means of reducing injury to corn plants from rootworm feeding damage. Most planting-time granular soil insecticides (except for Aztec and Fortress) labelled for corn rootworms are also labelled for use at cultivation. Incorporate granules with 1-2 inches of soil after application; effectiveness may be decreased unless the insecticide is incorporated.

Other options include the use of Furadan 4F and the use of chemigation treatments with Lorsban 4E. Control with Furadan 4F will generally be improved if the treatment is cultivated into the soil, unless sufficient rainfall occurs after application to move the insecticide down into the root zone. Lorsban 4E applications should be timed for the first appearance of second instar corn rootworms. Additional information on suggested insecticides, rates and restrictions is available at *http://www.ianr.unl.edu/ianr/entomol/instabls/crwlarv1.htm*

Bob Wright
Extension Entomologist
South Central REC, Clay Center

Duration of immature stages of western corn rootworm at constant temperatures

	Days to complete stage (male/female) at different constant temperatures (F)			Degree days to complete stage (48.2 F base)	
Stage	*64.4*	*69.8*	*75.2*	*Males*	*Females*
1st instar larva	8.1/8.6	5.6/6.2	4.8/5.3	70.4	77.7
2nd instar larva	6.8/7.1	4.9/5.4	4.3/4.9	61.7	70.6
3rd instar larva	15.0/15.5	11.2/11.9	9.4/10.4	140.5	149.2
Pupa	13.5/13.8	10.1/10.1	7.8/8.4	122.2	125.1
Hatch to adult emergence	43.4/45.0	31.8/33.6	26.3/28.9	394.8	422.6

Source: Jackson & Elliot, 1988, Environ. Entomol. 17:166-171.

Focus on GMOs

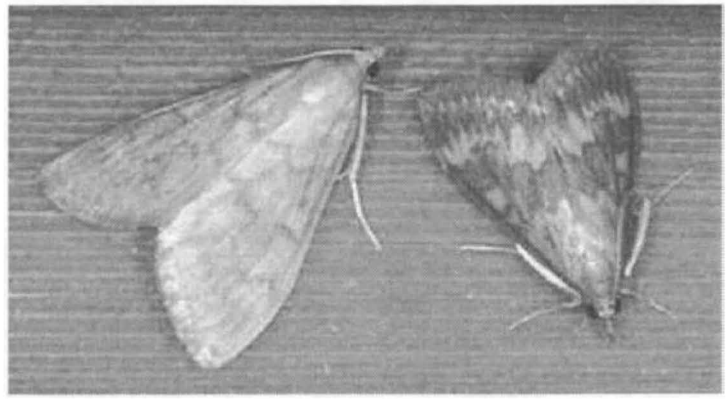
Over the next few issues, *Crop Watch* will feature information related to the production and marketing of GMOs. This week's stories (pages 107-111) with UNL Agronomy Professor Don Lee lead the series.

European corn borer *(Continued from page 105)*

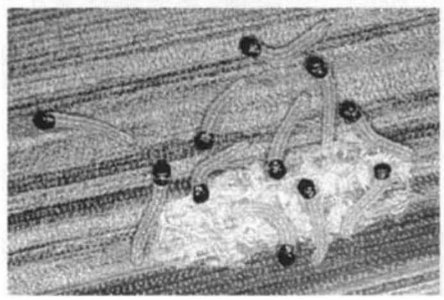
cally less than 4%) which does not produce sufficient toxin levels to kill corn borer larvae. If greater than 4% of plants show significant leaf feeding damage in a B.t. corn field, first check to confirm that corn borers are causing the damage (other caterpillars such as corn earworms or common stalk borer are not controlled by B.t. corns), then contact a representative of the company who sold the seed to investigate the situation.

To determine whether to treat for corn borers, survey fields for plants showing leaf feeding injury, and count the number of live corn borers. Check at least 25 plants in each of four areas of a field (100 plants total). Record the percentage of plants with shot-hole damage. Unroll two or more damaged plants at each site and record the number of live larvae per damaged plant. This will provide an estimate of the maximum number of borers that might survive to enter the stalk. Remember that natural mortality of corn borers is often high, due to insect natural enemies, diseases and weather. Avoid making treatment decisions until most borers are second instar, to take full advantage of this natural control.

Enter information from field scouting into the worksheet on page 114. This takes you through the calculations needed to estimate the potential yield loss if all these corn borers survive to bore into the stalk, the preventable loss if an insecticide is used, and the control costs. An interactive version of the worksheet is available at *http://www.ianr.unl.edu/forms/forms.skp/ecb_1st.html*



European corn borer moth *(Photo courtesy Iowa State University)*



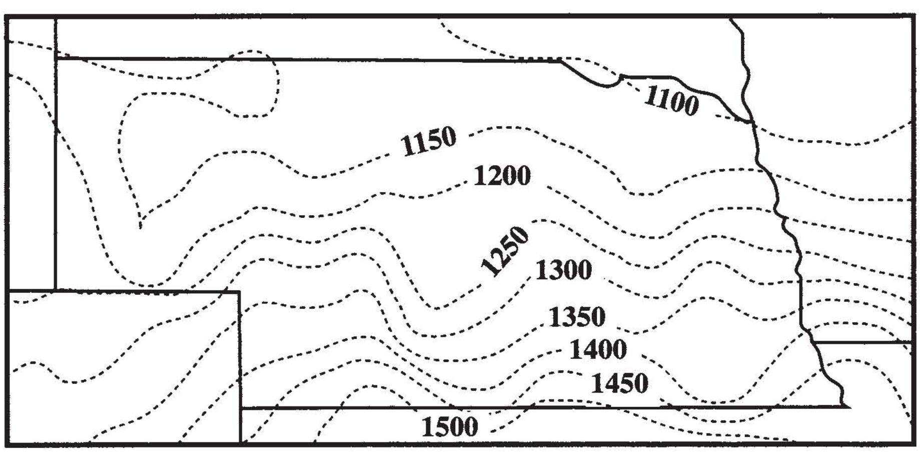
European corn borer egg mass and emerging larvae

Treatments will be effective only if borers are still feeding in the whorl. Treatments made after corn borers begin to bore into the stalk (when they are about half grown) will not be effective. Stalk boring usually begins in the fourth instar, which should begin at 567 degree days after first moth catch. Based on research data, the best control is achieved with granular formulations or applications through sprinkler irrigation systems, which provide the best penetration of insecticide into the whorl where the corn borer larvae feed.

Consider using products with *Bacillus thuringiensis* (B.t.) such as Dipel, Biobit, Thuricide, M-Peril, Condor, and others. These products effectively control first generation European corn borers without reducing the populations of insect natural enemies, and offer reduced risk to applicators. Refer to *http://www.ianr.unl.edu/ianr/entomol/instabls/ecb1st.htm* for a list of suggested insecticides, rates and restrictions.

Additional information on scouting and treatment thresholds for first generation corn borer is available in *First Generation European Corn Borer Scouting and Treatment Decisions*, NebFact 98-364, available from your local cooperative Extension office or at *http://www.ianr.unl.edu/ianr/entomol/ecb/ecb1.htm*

Bob Wright, Extension Entomologist, South Central REC



Common stalk borer GDD count

Scout for common stalk borer larvae in corn when about 1300-1400 degree days have accumulated. Control between 1400 and 1700 degree days.

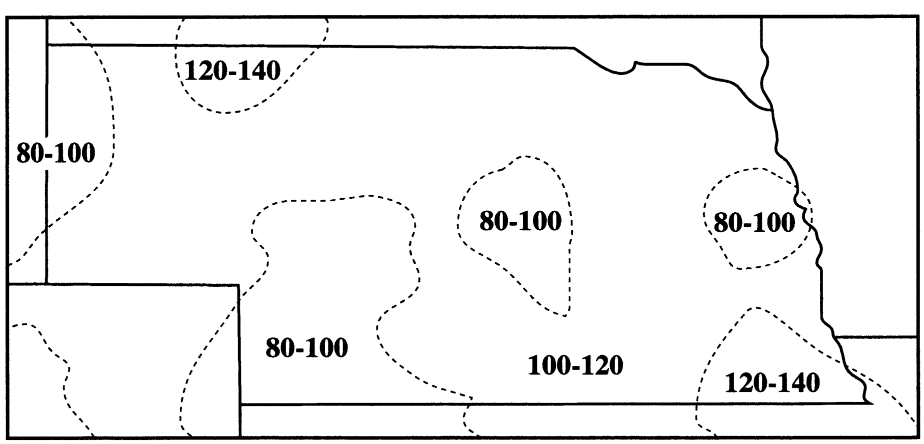
First generation European corn borer worksheet

An interactive version of this worksheet is available on the web and will calculate the findings for you. It is available at *http://www.ianr.unl.edu/forms/forms.skp/ecb_1st.html*

	Example field	*Your estimate*
1. Yield potential for this field	200 bu/acre	______ bu/acre
2. Number of larvae/infested plant = average live larvae/infested plant x average percent infestation (4 larvae x 50% infestation = 2 larvae/plant)	2 larvae/plant	______ larvae/plant
3. Potential yield loss (2 larvae/plant x 5% loss/larva = 10% loss in yield, 10% x 200 bu/acre = 20 bu/acre loss)	20	______
4. Dollar loss/acre (20 bu/a x $2.00 per bu = $40.00/acre loss)	$40.00	______
5. Preventable loss (if chemical is 75% effective = $40.00 x 75% = $30.00)	$30.00	______
6. Cost of chemical (ex. $8.00/acre) and cost of application (ex. $4.50/acre)	$12.50	______
7. Compare preventable loss ($30.00/acre) with total cost of treatment ($12.50/acre) or $30.00/acre - $12.50/a = $17.50 saved by the treatment	+ $17.50	______

Put away your calculator — use ours

If you use the Web, try an interactive version of the worksheet featured on page 114. In the privacy of your own home you can input your scouting numbers and the program will respond with whether a treatment is necessary. The worksheet is available at *http://www.ianr.unl.edu/forms/forms.skp/ecb_1st.html*



Precipitation: Percent of normal for Sept. 1 to May 31.
Accumulated precipitation during that period ranged from 8 inches in western Nebraska to 24 inches in southeast Nebraska.